Performance of Green Gram (*Vigna radiata* L. Wilczek) under Varying Levels of Nitrogen Fertilizer

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Abstract
An experiment was conducted during summer season of 2016 and 2017 at Instructional farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, India to study the "Effect of varying levels of nitrogen fertilizer on the performance of Green gram (*Vigna radiata* L. Wilczek)". The experiment was carried out in Randomized Completely Block Design with 9 treatments and 3 replicates. Pooled data of the experiment showed that treatment receiving (T_6) 25 kg nitrogen ha^{-1} in the form of urea recorded the highest growth attributes namely leaf area index (1.30), dry matter accumulation (18.10 g $plant^{-1}$), no. of nodules (35.62) and yield attributes namely no. of pod $plant^{-1}$ (19.49), pod length (10.37 cm), no. of seed pod^{-1} (12.57) and 1000 seed weight (49.03 g), which leads to more grain (920.68 kg ha^{-1}) and straw yield (2200.37 kg ha^{-1}) followed by 30 kg N ha^{-1} (T_7) and 35 kg N ha^{-1} (T_8). Treatment receiving no nitrogen (T_1) recoded significantly lowest values of all growth and yield attributes. For every kilogram increase of nitrogen beyond 25 kg. There was a yield reduction to the extent of 8 to 16 kg ha^{-1}. Seed protein content (21.61%) and protein yield (199 Kg ha^{-1}) were also found to be highest in T_6 which is very important as nutritional aspects of green gram might be due to more uptake of nitrogen (54.60 kg ha^{-1}).

Key Words: Green gram, Nitrogen, Nitrogen uptake and Protein
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Introduction

Green gram is one of the most ancient and extensively grown self pollinated leguminous crop which is grown during kharif (July-October) as well as summer (March- June) seasons in arid and semi arid regions of India. It is primarily a rainy season crop but with the development of early maturing varieties, it has also proved to be an ideal crop for spring and summer season. It is tolerant to drought and can be grown successfully on drained loamy to sandy loam soil in areas of erratic rainfall.

Nitrogen is an essential macronutrient needed by all plants to thrive. It is an important component of many structural, genetic and metabolic compounds in plant cells. It is also one of the basic components of chlorophyll; the compound by which plants use sunlight energy to produce sugars during the process of photosynthesis. Understanding the nitrogen requirements for plants makes it easier to meet their supplement needs. Therefore, nitrogen is applied to the crop as per its need for better growth. Akram *et al.* (2004) remarked that the addition of even small amounts of nitrogen (N) into agricultural lands can increase the growth and yield of crops effectively. Although N accounts for 78% of the air volume, its availability is relatively poor because only few plants (pulses) can utilize it directly from the atmosphere. Consequently, the supply of available N often becomes inadequate especially during the critical growing periods of plants. Applications of nitrogen increase the source capacity, namely, leaf area, leaf area index (LAI), early canopy closure and the rate of photosynthesis (Doughton *et al.*, 1993). Though green gram can fix atmospheric nitrogen, an application of 15 to 20 N kg/ha as starter dose at sowing, depending upon the initial fertility of the soil appeared to be optimum for the crop. However, the degree of response depends on inherent soil fertility, soil moisture, temperature and the cropping patterns followed. Keeping the above facts in mind present experiment has been conducted to find out the optimum dose of nitrogen for better green gram production.

Materials and Methods

The experiment was conducted during pre-kharif season of 2016 and 2017 at the Instructional Farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal. Cooch Behar is situated in the terai agro climatic zone at 26°19'86" N latitude and 89°23'53" E longitude and at an elevation of 43 meters above mean sea level. The soil of the experimental site was sandy loam having pH 5.51, organic carbon 0.74 %, available nitrogen 158.19 kg ha^{-1}, available phosphorus 25.30 kg ha^{-1} and available potassium 112.20 kg ha^{-1}. The experiment was laid out in randomized complete block design with three replications and net plot size was 5 m x 4 m. The experiment comprised of the nine treatments T_1 = No nitrogen fertilizer (control); T_2 = Nitrogen@5 kg ha^{-1}; T_3 = Nitrogen@10 kg ha^{-1}; T_4 = Nitrogen@15 kg ha^{-1}; T_5 = Nitrogen@20 kg ha^{-1}; T_6= Nitrogen@25 kg ha^{-1}; T_7 = Nitrogen@30 kg ha^{-1}; T_8 = Nitrogen@35 kg ha^{-1} and T_9 = Nitrogen@40 kg ha^{-1}. Green gram variety Pusa Baishaki was sown with the help of tyne in the row at a row distance of 30 cm on April 13th and March 14th during 2016 and 2017, respectively. A plant spacing of 10 cm within the rows was maintained by thinning done after 15 days of sowing. Nitrogen was applied as per treatments in the form of urea (46% N), phosphorus @ 50 kg ha^{-1} in the form of single super phosphate (16% P_2O_5) and potassium @ 30 kg ha^{-1} in the form of Muriate of potash (60% K_2O); and they were applied below the seeds at the time of sowing of the crop. The data on agronomic parameters were recorded during the course of investigation by using standard procedures. The total uptake of nitrogen at harvest was determined on dry weight basis by multiplying the total dry matter of the crop with its corresponding content. The protein content in grain was obtained by multiplying the total nitrogen content by empirical factor 6.25 (Mckenzie and Wallace, 1954) based on assumption that average protein contains 16% nitrogen by weight.

Results and Discussion

Growth attributes

Dry matter accumulation and leaf area (LA 7) recorded at 60 DAS was found to be highest (18.10 g plant^{-1} and 1.30) under T_6 (nitrogen @ 25 kg ha^{-1}) followed by T_7, T_8, T_5, T_9 , T_4 ,T_3 and T_2, while T_1 recorded lower values for all these growth attributes (Table 1). Nitrogen is an integral part of chlorophyll, which is the primary absorber of light energy needed for photosynthesis, which leads to greater leaf area and dry matter production.

Number of nodules plant^{-1} decreased with increased levels of nitrogen and found highest (44.83) at control plot (T_1) where no nitrogen has been added. The probable reason might be due to attraction of more rhizobia towards roots of green gram under nitrogen stress conditions.

Yield attributes and pod yield

Increased levels of nitrogen fertilizer up to 25 kg ha^{-1} has pronounced effect on yield attributes of green gram and recorded significantly highest values of number of pod plant^{-1} (19.49), pod length (10.37 cm), no. of seed pod^{-1} (12.57) and 1000 seed weight (49.03 g) during both the years of investigation, which ultimately leads to higher seed (920.68 kg ha^{-1}) and straw yield

Table 1: Growth, yield attributes and yields of green gram as influenced by varying levels of nitrogen fertilizer

Treatments	No. of nodules plant^{-1} at 60 DAS	Dry matter accumulation (g plant^{-1}) at 60 DAS	LAI at 60 DAS	No. of pod plant^{-1}	Pod length (cm)	No. of seed pod^{-1}	1000 seed weight (g)	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Nitrogen uptake (kg ha^{-1})	Protein content (%)	Protein yield (kg ha^{-1})
T_1	44.83	10.48	0.96	12.77	7.99	8.11	37.64	409.78	1524.17	21.78	15.98	65.41
T_2	44.23	11.36	0.97	16.32	8.21	11.03	39.81	674.03	1757.45	33.75	17.46	117.26
T_3	43.14	11.56	1.06	16.80	8.50	11.37	40.14	778.17	2098.23	41.83	18.30	142.42
T_4	42.19	13.06	1.11	17.72	8.75	11.40	40.75	793.43	2164.35	44.87	19.52	154.81
T_5	36.08	15.35	1.18	18.04	9.05	11.60	42.20	811.39	2065.11	46.37	20.16	163.51
T_6	35.62	18.10	1.30	19.49	10.37	12.57	49.03	920.68	2200.37	54.60	21.61	199.00
T_7	35.19	16.35	1.26	19.21	9.53	11.90	44.57	839.33	2135.92	49.49	20.59	172.80
T_8	31.73	15.88	1.20	18.46	9.13	11.80	44.16	820.43	1983.61	46.71	20.31	166.69
T_9	27.78	14.61	1.14	17.89	8.91	11.57	40.52	799.27	2068.90	44.79	19.63	156.78
S Em (±)	1.86	1.21	0.11	1.86	0.42	0.37	1.43	15.04	43.87	1.03	0.32	3.86
CD(p=0.05)	5.64	3.17	NS	NS	1.28	1.29	4.32	45.48	132.64	3.11	0.97	11.69

(2200.37 kg ha^{-1}) of green gram corresponding to T_6 during both years of investigation. The positive response to application of 25 kg nitrogen ha^{-1} may be attributed to the better nutrient availability and its favourable effect on soil physical and biological properties resulting in increased growth and yield attributes and finally higher yields. The results are in close agreement with the observation of Yakadri *et al.* (2004) and Singh *et al.* (2011). T_1 (No nitrogen) recorded significantly lowest values of all yield attributes and final seed yield.

Nitrogen uptake

Results on nitrogen uptake by green gram (Table1) revealed that there were great variations in nutrients uptake by green gram due to different treatments. Based on pooled data it was found that treatment receiving 25 kg N ha^{-1} (T_6) recorded significantly highest nitrogen uptake (54.60 kg ha^{-1}). The lowest being under T_1 (21.78 kg ha^{-1}). Increased nitrogen uptake might be due to consistent supply of nitrogen throughout the crop growth period and reduced loss of applied nitrogen, which helps in producing higher grain and straw yield.

Protein content and yield

Pooled data (Table 1) revealed that T_6 recorded significantly highest protein content (21.61%) and protein yield (199 kg ha^{-1}). The lowest protein content (15.98%) and protein yield (65.41 kg ha^{-1}) were given by T_1 treatment.

Conclusion

On the basis of the present findings, it can be concluded that during summer season short duration variety of green gram like *Pusa Baishaki* would be a good option for the farmers of terai zone. A starter dose of 25 kg nitrogen ha-^{1} was found to be optimum along with 50 kg phosphorus and 30 kg potassium for harnessing maximum green gram yield.

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